

d. Acceptability. The viability of a given modification to the authorized project and it's acceptance by the non-federal project sponsor, state entities and the public, and compatibility with existing laws, regulations, and public policies.

84. Four accounts are established to simplify evaluation and display of effects of alternative plans. These four accounts encompass all significant effects of a plan on the human environment as required by the National Environmental Policy Act of 1969 (NEPA). They also encompass social well-being as required by Section 122 of the 1970 Flood Control Act. The national economic development account is included, since it is the primary Federal objective. Other information that is required by law or that will have a material bearing on the decision-making process is included in the other accounts listed below:

a. National Economic Development (NED). This account displays changes in the economic value of the national output of foods and services.

b. Environmental Quality (EQ). This account displays non-monetary effects on significant natural and cultural resources.

c. Regional Economic Development (RED). This account registers changes in the distribution of regional economic activity that result from project construction. Evaluations of regional effects are to be carried out using nationally consistent projections of income, employment, output, and population.

d. Other Social Effects (OSE). This account registers project effects from perspectives that are relevant to the planning process, but are not reflected in the other three accounts.

85. Interagency Coordination. Interagency collaboration through all stages of project development and implementation is paramount to the success of the Civil Works Program. In the interest of interagency coordination on planning studies and trying to avoid issues arising very late in the planning process, the following have been applied to the Coast of Florida Region III study:

86. Interagency Coordination. Interagency collaboration through all stages of project development and implementation is paramount to the success of the Federal Civil Works Program. The purpose of interagency coordination on planning studies is to avoid issues arising very late in the planning or preconstruction engineering and design process

which would delay project implementation. A brief summary of the interagency coordination for this study follows:

a. Meetings:

January 28 1985 Workshop. A coordination meeting was held including an initial technical workshop session on coastal processes with Corps representatives from Jacksonville District, Mobile District, South Atlantic Division, Washington, and the Coastal Engineering Research Center. Representatives from the Florida Department of Natural Resources, the University of Florida, the University of Miami, the University of California at Berkley, Florida Sea Grant, Florida Shore and Beach Preservation Association, the Florida Office of Coastal Zone Management, and the National Ocean Service attended. Corps representatives from South Pacific Division, Los Angeles District and San Francisco District provided information relating to the Coast of California study. The meeting included evaluation of the study's Congressional authority, goals and objectives by the study participants.

February 26, 1985 Meeting. This meeting was held with representatives from the Corps' Jacksonville District, Mobile District, and the Coastal Engineering Research Center. Representatives from the Department of Natural Resources, the U.S. Fish and Wildlife Service, and the Office of the Governor attended. The meeting was the initial coordination effort to establish an environment data base and to discuss the scope of the necessary environmental studies. This was followed by a meeting on March 18, 1985 with representatives from the Corps' Jacksonville and Mobile Districts, the Department of Natural Resources, the U.S. Fish and Wildlife Service, and the National Coastal Ecosystems Team from the U.S. Fish and Wildlife Service office in Slidell, Louisiana. This meeting focused on possible utilization of the Slidell computer and graphic capabilities.

April 1, 1985 Meeting. A coordination meeting was held to involve county interests from Region III in the study. Corps representatives from Jacksonville District, Mobile District, South Atlantic Division, and the Coastal Engineering Research Center attended. Representatives from the Florida Department of Natural Resources, the University of Florida, the University of Miami, and representatives from Dade, Broward and Palm Beach Counties attended. The study schedule network and scopes of work were discussed. Data collection and analysis needs for development of regional coastal processes numerical models were discussed.

June 27, 1991. A meeting was held in Ft. Lauderdale to meet with representatives of Dade, Broward and Palm Beach Counties to discuss the need and scope of environmental work, particularly side scan sonar. The Florida Department of Natural Resources also attended.

May 6, 1992. A meeting was held to review the progress of the study in Atlanta, Georgia. Corps representatives from Jacksonville District, South Atlantic Division, Washington and the Coastal Engineering Research Center attended, along with the members of the Florida Department of Natural Resources. The civilian members of the Coastal Engineering Research Board, Dr. Robert Reid, Dr. Robert Dalrymple, and Dr. Fredric Raichlen, were briefed on scopes, schedules and technical aspects of the study, particularly regional numerical modeling and the use of GIS for coastal applications.

October 22-26, 1992. A beach-inlet workshop was held. Approximately 45 persons attended, including representatives from SAJ, SAD, CERC, DNR, five universities, and five consulting firms. The beach/inlet interactions with respect to coastal processes and coastal engineering technology for effective management, and relevance of current issues to the inlets in Region III was the focus of the meeting. The meeting focus was to develop a pro-active framework for future work using a regional and integrated management approach.

December 14, 1993. A Technical Review Conference (TRC) was held. Representatives from the Corps' Jacksonville District, South Atlantic Division, Washington office, and the Coastal Engineering Research Center attended. Representatives from the Florida Department of Environmental Protection, Dade County, Broward County and Palm Beach County attended. The U.S. Fish and Wildlife Service was invited, but did not attend. The preliminary alternative plans were discussed, along with other items such as cross-shore and longshore numerical modeling and GIS developments. The status of environmental, economic, geotechnical and other related studies was presented.

Coordination meetings with the Coastal Engineering Research Center were held on: November 14, 1990; January 15-16, 1991; August 13, 1991; and November 8, 1994.

Coordination meetings were held with the Florida DEP in Tallahassee on the following dates: February 11, 1991; March 8, 1991; November 20, 1991; December 3, 1991; March 27, 1992; September 22, 1993; and April 7, 1994.

Coordination meetings were held with the Florida DEP in Jacksonville on the following dates: October 20, 1991; April 22, 1992; and August 20-21, 1992.

**b. Published Documents:**

Numerous reports have been published relating to study topics. A Preliminary Draft Region III Feasibility Report dated October 1994 has been prepared. The report was coordinated with SAD, HQ, CERC, DEP and Dade, Broward and Palm Beach Counties. In particular, the preliminary recommendations for project modifications were included in the report, and later discussed at the meeting held in December 1994.

Newsletters for the study were prepared as part of the public coordination effort. The coordination mailing list contains over 500 addresses. The following newsletters have been issued: Volume 1, Number 1, Coast of Florida Erosion and Storm Effects Study UPDATE, January 1992, Study overview. Volume 1, Number 2, Coast of Florida Erosion and Storm Effects Study UPDATE, August 1993, GIS overview.

**c. Conferences -**

The study progress is presented at the annual meeting of the Florida Shore and Beach Preservation Association (FSBPA). Study progress has been reported at this conference annually since 1986.

Coastal Zone 91/Waves 91 - July 1991 Presentations of Region III wave data were made.

The FSBPA Technical Conference in January 1993 and the ASCE Hurricane Conference in December 1993. A presentation on the Impacts of Andrew on Region III was made.

d. Federal agencies were invited to be cooperating agencies as defined by NEPA. Environmental scoping letters were sent to EPA and F&WS. This and other resource agency coordination is summarized in the draft accompanying this report.

**STATE OBJECTIVES**

**Introduction**

87. Florida's ocean coastline is among the most diverse shorelines in the United States, containing barrier islands, mangrove swamps; coral keys; and long, sandy, mainland beaches. Barrier islands, spits, and capes line much of

Florida's east coast, the panhandle, and the southern two-thirds of the west coast. The Florida Keys, which are geologically different from the rest of the Florida coast, consist of uplifted coral reefs and carbonate sand banks.

**88.** Florida is now the third most populous state in the U.S. From 1970 to 1980 the population increased by approximately 3 million people, and the state's population is predicted to total nearly 17 million by 2010 (Godschalk et al., 1989). A very high proportion of Florida's population lives in coastal counties. Furthermore, the majority of the state's 32 million tourists visit and stay near the coast (Florida Atlantic University, 1986). The resulting development pressure is greatest on Florida's barriers and mainland sandy beaches.

**89.** Approximately 538 miles of Florida's 802 miles of sandy beach shoreline are privately owned. About one-fifth of such private, sandy shorelines remains largely undeveloped. During the 1980's, approximately 15 miles of shoreline, just under 2 percent of Florida's sandy beaches, were newly developed. In the same period, public ownership of coastline increased by approximately 9 percent with the acquisition of 22 miles (Florida Division of Beaches and Shores, 1990).

**90.** Florida is potentially more vulnerable to hurricanes and coastal storms than any other U.S. state. Of the hurricanes that made landfall on the U.S. mainland in the last century, nearly 60 percent hit the Florida coast (Godschalk et al., 1989). Furthermore, all of the state's 8,400 miles of tidal shoreline are low-lying and vulnerable to serious hurricane flooding (Kusler, 1983). Hurricane occurrences in Florida have been very cyclical. During the period 1911 to 1920, only one tropical storm occurred within a 50-mile radius of Dade County. This compares to 1941 to 1950, when 14 hurricanes and three tropical storms once within a 50 mile radius of Region III. The most recent hurricane to strike Region III, Hurricane Andrew, devastated southern Dade County in August 1992.

**91.** Over one-third of the Florida's beaches are eroding. Of the 820 miles of shoreline surveyed, the Florida Division of Beaches and Shores has identified 338 miles of Florida's shoreline as "problem erosion areas." Of these 338 miles, 95 miles along the Gulf and 124 miles on the Atlantic are designated as "critical erosion areas" - stretches of shoreline where erosion threatens substantial development and recreational interests (Clark, 1990).

**92.** Historically, Floridians used erosion control structures to stabilize their shifting shorelines.

Florida's first seawall was built in 1690 in Saint Augustine. Today bulkheads, seawalls, and revetments are common along the Florida shore, and jetties lie along many of the inlets between barrier islands. Since the 1960's, Florida has increasingly turned to beach restoration and renourishment to preserve the state's eroding beaches. By October 1993, about 73 miles of Florida's shoreline were renourished as part of authorized Federal projects. About half of Florida's beach replenishment projects (34.3 miles) have been undertaken in the state's heavily developed southeastern counties in Region III. In 1982, the largest project in Florida was completed, the Dade County Hurricane and Storm damage project. The project required moving 13.2 million cubic feet of sand from offshore sources, cost \$54.5 million for initial construction, and \$10.7 million for subsequent periodic nourishment. Through 1994, another 425,000 cubic yards of sand was back placed on the project's beaches.

### **Coastal Management Program**

93. Florida's Coastal Management Program was established under the Coastal Management Act of 1978 (Florida Laws, Chapter 380) and approved by the Federal Coastal Zone Management office in 1981. Florida does not regulate its coastal zone through one comprehensive law, but rather through 25 state statutes. Although the Department of Environmental Regulation is the lead coastal program agency, 16 other state agencies are involved in administering the program (Balsillie, 1988). In particular, the Department of Natural Resources (DNR), which regulates coastal development, and the Department of Community Affairs play key roles in the coastal management program.

### **The Beach and Shore Preservation Act**

94. The Beach and Shore Preservation Act (Chapter 161, Florida Statutes) is Florida's primary statute for regulating coastal development. The act, which is administered today by the Department of Environmental Protection (DEP), Bureau of Beaches and Coastal Systems (BB&CS), was first passed in 1965 and has since been significantly amended (Florida Atlantic University, 1986). In the act, the legislature asserted that Florida's beaches and coastal barrier dunes are among the state's most valuable natural resources and that these resources should be protected from "imprudent construction which can jeopardize the stability of the beach-dune system, accelerate erosion, provide inadequate protection to upland structures, endanger adjacent properties or interfere with public beach access" (161/053).

## **Coastal Construction Control Lines**

95. To ensure that such "imprudent construction" does not take place, the statute charges the DEP to define and establish Coastal Construction Control Lines (CCCL). These lines define the landward limit of the active beach-dune system and vary from a few to several hundred feet inland of mean high water. The specific location of the line is a function of the predicted storm surge and erosion resulting from a 100-year storm. The DNR has established control lines on a county-by-county basis for Florida's 24 sandy beach counties (161/053). Nine of Florida's 33 coastal counties are not considered to be predominantly sandy beach counties and do not, therefore, have CCCL's. The unregulated counties stretch from Wakulla to Pasco County, located on the Big Bend, and Monroe County in southern Florida (Balsillie, 1988).

96. Florida is one of the first States to develop a coastal construction control line program. This program was initiated through legislative action in 1970. The primary goal of this program was the control of coastal construction to curtail impactive and imprudent development. Included in this effort was the establishment of a coastal monumentation program for survey and documentation purposes. Control monuments have been established approximately every 1,000 ft along the coastal shoreline of all beach front areas, generally located on the shoreward side of existing dune lines away from normal shoreline erosion forces. These monuments serve as the starting reference for beach survey purposes. Massive primary monuments are located further landward and serve as primary monuments for all controlled survey work. All monuments are tied to the State Plane coordinate system.

97. Using numerical modeling storm programs and engineering expertise, including historical shoreline studies and recent survey data, the State has established coastal construction control lines that reflect the determined 100-year storm impact location along each stretch of beach front property. Acceptance of this line goes through an elaborate review process and is finally established as a regulatory line for construction purposes.

98. The CCCL is a line of regulation-not of prohibition (Robert Dean, University of Florida, personal communication, June 1989). Prior to building or excavating seaward of the control line, a permit must be obtained from the DEP. The primary purposes of this permitting program are to 1) ensure that construction seaward of the control line is designed and sited to protect beaches and dunes from damage, 2) ensure that construction seaward of the line does not result

in accelerated erosion on adjacent land, and 3) increase the chance that structures seaward of the line will survive severe storms (Florida Atlantic University, 1984).

99. Before granting a coastal construction permit, the DEP must consider: 1) shoreline stability and the impact of storm tides; 2) design features of the proposed structures or activities; and 3) potential impacts of the building or activities, including cumulative effects, on the beach-dune system. The department may grant a building permit in areas where a "reasonably continuous" line of existing construction located seaward of the control line is not "unduly threatened by erosion" (161/053).

100. The Beach and Shore Preservation Act also regulates construction of shore protection devices below mean high water (161/041). Prior to building such a structure, a coastal construction permit must be issued by the DEP. Certain types of structures and activities are exempt from the permit program: 1) construction on vegetative non-sandy shores; and 2) modification, maintenance, or repair of existing structures within the limits of existing foundations (Florida Atlantic University, 1986).

101. Florida's Administrative Code (16B-33) sets specific standards and regulations for construction seaward of the control line: 1) all habitable structures must be pile-supported, elevated above the projected 100-year storm surge, and designed to withstand 140 mph winds; 2) existing beach topography must be protected; 3) the maximum effort must be made to protect all native, stabilizing vegetation; 4) seawalls and all nonessential coastal protection structures are generally not permitted; 5) in severely eroding areas, structures must be located as far landward as possible; and, 6) all construction must be designed to minimize erosive effects.

102. Before setting control lines, the DEP must hold a public hearing in the affected county. The results of the hearing must be considered prior to determining the location of the control line (161/053). Once the department has established CCCL's, their location must be recorded in public records (161/053).

103. To determine the appropriate location of a control line, the state considers long-and short-term erosion rates, existing upland development, and expected impacts of a 100-year storm. The state contracts with the Florida State University Beaches and Shores Resource Center to assess the impacts of predicted hurricane storm tides. The center uses the storm tide model developed by Dr. Robert Dean to predict



water levels, wave heights, and dune and bluff erosion accompanying a 100-year storm event (Balsillie, 1988).

104. For each control line study, stereoscopic aerial photographs are taken. These are then reproduced to provide detailed maps with a 1:100 scale (Balsillie, 1988). These maps are compared to historical maps, beach profile surveys, and photographs to determine long-term erosion rates. For a typical county, five to six surveys, dating from the mid-1800s to the present, are used to compute erosion rates (National Research Council, 1990).

105. To measure shoreline change over relatively short time periods, the state has established over 3,400 concrete monuments at 1,000-foot intervals along the coastline (National Research Council, 1990). These monuments are in turn referenced to a system of larger monuments that are located farther inland. As part of the state's ongoing CCCL delineation and monitoring program, beach profiles are periodically measured from the control line monuments. In addition, the state also conducts post-storm surveys that provide Florida with a comprehensive pre-and post-storm data base (Balsillie, 1988).

#### **Erosion Setbacks**

106. The 1985 State Comprehensive Growth Management Act (Chapter 85-55) amended the Beach and Shore Preservation Act to include a construction setback provision for all sandy beach counties. The amendment prohibits the DEP from granting most coastal construction permits on land that will be seaward of the seasonal high water line within 30 years (161/053). The 30-year erosion projection cannot, however, extend landward of an established CCCL (161/053).

107. The DEP can grant coastal construction permits for shore protection structures, piers, and minor structures seaward of the 30-year setback line. The DEP will permit construction of a single-family residence seaward of the line only if: 1) the parcel was platted prior to adoption of the amendment, 2) the landowner does not own another parcel adjacent to and landward of the parcel proposed for development, and 3) the structure is located landward of the frontal dune and as far landward as practicable (161/053). In addition, repairs or reconstruction of a building cannot "expand the capacity of the original structure seaward of the 30-year erosion projection" (161/053). The department can, however, issue a permit for landward relocation of a damaged or existing structure if the relocation will not damage the beach-dune system (161/053).

**108.** The DEP uses long-term erosion rates to delineate the location of the 30-year erosion projection. DEP must also consider the presence of shore protection structures and beach renourishment projects in determining the appropriate location of the erosion projection (161/053).

### **Coastal Building Zone**

**109.** The 1985 Growth Management Act further amended the Beach and Shore Preservation Act to establish a coastal building zone extending landward of coastal construction control lines. Within the coastal building zone, strict building codes ensure that all major structures are designed and constructed to withstand the forces of and erosion caused by a 100-year storm event (Florida Atlantic University, 1986).

**110.** For mainland beaches, barrier spits, and peninsulas lying within Florida's sandy beach counties, the coastal building zone extends from the seasonal high water line to 1,500 feet landward of the coastal construction control line. On barrier islands, the entire island or the area from the seasonal high water line to a maximum of 5,000 feet inland from the control line is included in the building zone (161/54). All land areas within the Florida Keys, regardless of island size, also lie within the coastal building zone (Florida Atlantic University, 1986). In counties that lack CCCLs, the coastal building zone is equivalent to the National Flood Insurance Program's V-zone. (FEMA defines the V zone, which is a coastal high hazard area, as a special flood hazard area that extends from offshore to the inland limit of a primary frontal dune or any area subject to high velocity wave action from storms or seismic sources).

**111.** Within the coastal building zone, major structures must conform to the state minimum building code, be designed to withstand all anticipated loads resulting from a 100-year storm, and be constructed and located in compliance with NFIP regulations (161/55). The statute defines major structures to include houses, mobile homes, commercial and public buildings, and all other construction that has the potential to substantially affect the coastal zone (161/54). Minor structures, such as dune walkways, tennis courts, and gazebos, need not meet these standards, but must be designed to "produce the minimum adverse impact on the beach and the dune system" (161/54 and 161/55).

### **Erosion Control Program**

**112.** In 1986 the Florida legislature amended the Beach and Shore Preservation Act to address the statewide problem of

beach erosion through a "state-initiated program of beach restoration and beach renourishment" (161/101). The legislature declared that "beach erosion is a serious menace to the economy and general welfare of the people of this state and has advanced to emergency proportions" (161/088). Correspondingly, the legislature concluded that state management was necessary to ensure that Florida's beaches were properly managed and protected (161/088). Although the state had funded and participated in coastal erosion control projects since 1965, most of these projects were locally initiated and were not part of a comprehensive state plan (Florida Atlantic University, 1986).

113. The statute directs the DEP to develop and maintain a comprehensive long-term management plan for restoration of Florida's critically eroding beaches (161/101). The plan must: 1) address long-term solutions to the problem of severely eroding beaches; 2) evaluate each improved navigational inlet to determine its contribution to the erosion of adjacent beaches and provide specific recommendations for mitigating these impacts; 3) provide design criteria for beach restoration and renourishment projects; 4) evaluate feeder beaches as an alternative to direct beach restoration; and 5) establish a priority list for beach restoration land renourishment projects (Florida Atlantic University, 1986).

114. State funds for erosion control projects are available from Florida's Erosion Control Trust Fund (161/091). The fund provides money for erosion control; hurricane protection; and beach preservation, restoration, and renourishment projects (161/091). The state can pay up to 75 percent of the actual cost of restoring a critically eroding beach, while the local government in which the project occurs must provide the balance of the funds (161/101). State support for locally sponsored projects has largely been for beach restoration and renourishment and, to a lesser extent, dune restoration, revegetation, and dune walkovers (Florida Atlantic University, 1986). See Table 8 annual for DEP expenditures.

115. For a project to be eligible to receive state monies, it must meet two criteria. First, the project must establish an "erosion control line," which is equivalent to the mean high water line prior to beach restoration. After the beach is renourished and correspondingly widened, the erosion control line marks the boundary between state and upland ownership and guarantees public use of the beach seaward of the line. Second, the project applicant must provide public access points with adequate parking facilities at one-half-mile intervals along the restored beach (Balsillie, 1988). The existing erosion control lines

are shown on the selected plan plates following the main text.

**116.** In 1986, as part of the comprehensive long-term plan for the management and restoration of Florida's critically eroding beaches, the Division of Beaches and Shores began identifying and classifying the state's eroding beaches (Clark, 1990). The division grouped Florida's erosion problems into three categories: 1) areas with high erosion rates; 2) areas with moderate or low erosion rates, but with a narrow beach fronting a highly developed area; and 3) restored beaches with an active maintenance program (Clark, 1990). These areas were then further defined as either: 1) "critical erosion areas," where erosion threatens substantial development or recreational interests; or 2) "noncritical erosion areas," where erosion processes do not currently threaten development or recreational interests (Clark, 1990). These categories of erosion are shown on plates 1-15 for Region III, in the main text.

#### **Local Comprehensive Planning**

**117.** The Local Government Comprehensive Planning Act of 1975 (Chapter 163, Florida Statutes) requires that all local governments prepare, adopt, and implement comprehensive plans that address community growth and development needs. In the 1985 Growth Management Act, the Florida legislature strengthened the Planning Act in coastal areas and required that local, regional, and state comprehensive plans be consistent with each other. Under the Planning Act, coastal localities must include a "coastal management element" in their local plans (Godschalk et al., 1989). This section of the plan must be based on an inventory of the beach-dune system and existing coastal land uses and an analysis of the effects of future land uses on coastal resources (Florida Atlantic University, 1986).

**118.** Within the plan's coastal element, local governments must address disaster mitigation and redevelopment, designation of coastal high-hazard areas, beach protection, and shoreline use. The local plans must fulfill, among others, the following primary objectives: 1) protection of coastal resources; 2) limitation of public expenditures that subsidize development in coastal high-hazard areas; 3) direction of population away from coastal high-hazard areas; 4) management of development and redevelopment in coastal high-hazard areas to minimize risks to life and property; and 5) protection and enhancement of beach-dune systems (Florida Atlantic University, 1986; Godschalk et al., 1989).

**119.** If a local plan does not meet the requirements of the Growth Management Act, state funds to that jurisdiction may

be curtailed (Godschalk et al., 1989). Furthermore, the state cannot issue funds to increase the capacity of local infrastructures unless improvements are consistent with the coastal management element in the local plan. The state can also restrict a locality from receiving post-disaster federal assistance. The state may choose not to include local projects on all state applications to the Federal Emergency Management Agency unless the municipality has adopted hazard mitigation and prevention plans (Godschalk et al., 1989).

### **Coastal Barrier Regulations**

120. In the 1981 Coastal Barrier Executive Order (E.O. 81-105), the governor of Florida recognized the value of coastal barriers and set forth three requirements for state agencies that plan for, manage, and regulate the coastal zone. The governor directed that: 1) acquisition of coastal barriers was a priority; 2) federal and state money was not to be used to subsidize growth or post-disaster redevelopment on hazardous barriers; and 3) agencies were to manage growth in a manner consistent with the evacuation capabilities of coastal barriers (Florida Atlantic University, 1986).

121. The executive order did not provide state agencies with any specific powers to carry out its directives, but rather set for the overall policy for state actions on coastal barriers. Subsequently, in the 1985 Growth Management Act, the legislature enacted specific amendments to discourage growth and unwise development on coastal barriers (380/27 and 163/178). In particular, the act directed that state funds could not be used to build bridges or causeways to barrier islands that were not already accessible (Florida Atlantic University, 1986).

### **Coastal Acquisition**

122. Florida has one of the largest state acquisition programs in the country in terms of money spent and land purchased (Florida Atlantic University, 1986). Acquisition of coastal land is among the key components of the state's land protection program. Florida's Save Our Coasts program, authorized under the Land Acquisition Trust Fund (375/041), provides monies specifically for acquisition of coastal properties. Enacted in 1981, the Save Our Coasts program authorized a \$200 million bond issue for purchase of sandy beaches, barrier islands, and beach access points. Through July 1986, the program had purchased 2,713 acres of coastal land, representing 13 miles of shoreline (Florida Atlantic University, 1986). The state's coastal acquisition efforts target areas where the local government is willing to make a

financial contribution to purchase the land and to manage it after it is acquired. Parcels in areas with a need for additional recreational beaches and sites susceptible to repeated erosion are also the focus of the acquisition program (Glassman, 1983).

#### **FORMULATION OF ALTERNATIVE PLANS**

**123.** The alternative plans considered were developed through a three-step process. These three steps were:

a. Identification and preliminary assessment of possible solutions. Costs and benefits have not been computed.

b. Development and assessment of intermediate-level-of-detail alternatives. Unit price cost estimates and benefits have been computed. Includes general discussion of potential environmental impacts.

c. Development and assessment of detailed alternative plans. Cost code of account level cost estimates have been computed, including the costs of lands, easements, rights-of-way and mitigation. Detailed benefits have been computed. Federal and non-Federal cost allocation is discussed.

**124.** Each step was iterative in the process of identifying and selecting the best course of action. Each alternative was considered in light of other projects within each reach or problem area. During the first step, the population of alternatives developed included traditional type projects, programs that could be carried out by non-federal interests, and all suggestions surfaced by participants in the meetings and workshops held. Each plan in the array was screened based on its ability to satisfy the planning objectives. The viable plans were carried forward into the intermediate level of detail and analysis, and were developed sufficiently to assess generalized benefits, costs and impacts. Those plans meriting closer evaluation were carried into the third step, development and analysis of alternative plans on a detailed level.

#### **Systems Approach**

**125.** The Coast of Florida study authority mandates a study of the entire coast of Florida to include a determination of whether any modifications of existing Federal shore protection and navigation projects are advisable. In response to this authority, a regional approach was adopted. The key theme of this approach is that erosion and storm damage problems do not stop at political or municipal

boundaries, but rather have natural or physical limits. The physical boundaries of Region III are from Jupiter Inlet in Palm Beach County to the southern end of Key Biscayne in Dade County. These limits were selected since this portion of the east coast of Florida is sheltered from wave energy to a least some degree by the Bahama Islands. Within Region III, the study area was divided into adjacent reaches bounded by natural or manmade inlets, which serve to substantially interrupt or limit the continuity of natural longshore littoral processes. Each reach, or littoral cell, has similar natural process such as wave energy, geotechnical properties, littoral transport and associated beach and inlet processes.

126. Using a systems approach, a review of existing project impacts within each reach can be analyzed. Modifications to each project can be developed and other alternative plans considered within a systems context. The ultimate goal is to optimize the combined effectiveness and economic efficiency of the shore protection, navigation maintenance and dredged material disposal within each reach and adjoining reaches.

#### **Physical Processes**

127. The first step in a systems approach is to develop a sediment budget for the reach of coast under investigation. The sediment budget is based on modeling of sediment movement, empirical data, and estimates of net shoreline change rates over the past 50-year period, as well as the rate of change during the most recent decade. The effects and probability of occurrence of relevant storm events are determined. The magnitude of the average annual volumetric changes in beach area and volume for each reach are calculated. Plans are to be formulated using currently accepted design criteria for sea level rise (design is to be based on the historic rate of rise). A sensitivity analysis on what effect, if any, changes in the sea level rise rate would have on the plan evaluation and selection process is performed for those plans developed in detail.

#### **Without Project Conditions**

128. The man-made alterations to the shore, such as jetties, sand-bypassing and dredging, seawalls and other coastal armor, and artificial beach nourishment were inventoried. Their effect and contribution to the balance of littoral processes and shoreline changes was then determined. Based on this information and analysis, the without-project conditions were then established. These conditions by reach are summarized in Table 9. Determination of environmental resources and base conditions

TABLE 9

WITHOUT PROJECT CONDITIONS  
COAST OF FLORIDA STUDY - REGION III

Location	DNR Monument Range		Erosion Control Line Established?	Pre- Project Shoreline
<u>PALM BEACH COUNTY</u>				
Jupiter/Juno	R - 13	to R - 29	YES	1993
Lake Worth Inlet	R - 75	to R - 78	NO	1990
N. Palm Beach Island	R - 76	to R - 85	NO	1990
Palm Beach Island	R - 91	to R - 105	NO	1990
S. Palm Beach Island	R - 116	to R - 132	NO	1990
Ocean Ridge	R - 152	to R - 159	YES	1994
Delray Beach	R - 175	to R - 188	YES	1973
Highland Beach	R - 188	to R - 205	NO	1990
Boca Raton	R - 205	to R - 213	YES	1987
<u>BROWARD COUNTY</u>				
Deerfield Beach	R - 1	to R - 25	NO	1990
Pompano	R - 26	to R - 53	YES	1969
J. U. Lloyd	R - 86	to R - 98	YES	1976
Hollywood/Hallandale	R - 101	to R - 128	YES	1978
<u>DADE COUNTY</u>				
Golden Beach	R - 1	to R - 7	NO	1990
Sunny Isles	R - 7	to R - 20	YES	1987
Miami Beach	R - 27	to R - 74	YES	1974
Key Biscayne	R - 91	to R - 113	YES	1974

## Assumptions:

- 1) No upgrades on existing structures throughout the life of the project.
- 2) Structures condemned due operational, but ineffective.
- 3) Existing sand transfer plants at Lake Worth and South Lake Worth Inlets are operational, but ineffective.



were an integral part of defining the without project condition. Plates 1 through 16 document the position of the without project shoreline. The without project condition includes the effects of implementing all reasonably expected nonstructural and conservation measures.

### **Anticipated Shoreline Changes**

**129.** Determine beach erosion/shore protection nourishment and additional navigation-related dredging for the economic life of both existing and proposed measures, including dredging maintenance schedules and volumes at existing coastal inlets. This allows identification of the future "with" and "without" project conditions. Development of mitigation measures is developed for all alternatives, commensurate with the scope and phase of the planning effort, i.e, initial, intermediate and detailed plan formulation phases.

### **Economic Benefits and Costs**

**130.** Inventory potential damages, development plans and estimate the costs of maintaining existing shore protection and navigation projects in the current or without project condition. The cost of mitigation measures is developed along with other costs of alternative plan features. Monetary value are to be expressed in average annual equivalents by appropriate discounting and annualizing techniques using the applicable discount rate. The same period of analysis is used for all alternative plans, which for the purposes of this study, is selected to be 50 years. The period of analysis does not include the implementation or construction period. All benefits and costs are expressed as of the beginning of the period of analysis.

a. Assess the extent of damageable property through analysis of storm surge and wave damage, assess the loss of recreation, and determine project impacts to jetties, channels and other navigation features.

b. Determine damage reduction benefits to the coastal system or reach for various increments of shore restoration or project alternatives. Only that portion of prospective average annual system losses which would be eliminated by the plan, or net gains to the littoral system, is a proper measure of average annual benefits.

c. Evaluate all beneficial and adverse impacts for each project alternative in accordance with Principles and Guidelines. The P&G criteria and other Federal and study plan formulation objects were identified earlier.

131. The above criteria were used to formulate possible modifications to the authorized projects for Dade, Broward and Palm Beach Counties according to the study guidelines and objectives. These criteria assure that all possible alternative projects are formulated in a systematic and reasonable manner.

#### **Development of Enhanced Federal Projects**

132. Enhancements of authorized Federal projects are analyzed in COFS. These include:

- a. adjustments in berm widths for beach fill projects;
- b. creation of nearshore berms with the use of dredged maintenance material which would decrease advance nourishment quantities;
- c. sand-bypassing at inlets which would decrease renourishment intervals and quantities; and,
- d. filling in gaps between projects, i.e. Golden Beach between Hollywood/Hallandale and Sunny Isles, which would decrease end losses.

#### **Initial Development of Alternatives**

133. The possible solutions considered in the first step of project formulation are listed in Table 10. Many of the alternatives were not retained for intermediate analysis because they did not fully address the planning objectives. Planning objectives discussed earlier were the basis for the selection of alternative plans for development of intermediate level of detail and analysis. The alternative of taking no action must be included throughout the planning process. Non-structural measures were also considered as means for addressing problems and opportunities.

134. Section 103(a) of the 1986 Water Resources Development Act (WRDA) specifies that non-federal interests will contribute 5 percent of the cost of project assigned to flood control. Section 103(c)(5) specifies that hurricane and storm damage reduction projects are to be cost shared at a 65 percent federal and a 35 percent non-federal basis. Section 103(c)(4) states that recreation projects are to be cost shared at 50 percent of separable costs. Section 103(d) states that the cost of constructing projects or measures for beach erosion control and water quality enhancement shall be assigned to the appropriate purposes listed above.

**TABLE 10**  
**POSSIBLE SOLUTIONS AND PLANNING ACCOMPLISHMENTS**  
**COAST OF FLORIDA STUDY - REGION III**

POSSIBLE MEASURES	Local Planning Objectives (1)				Principles and Guidelines Accounts (2)			
	RB	FP	EC	TBE	NED	EQ	OSE	RED
<b>NONSTRUCTURAL MEASURES (NS)</b>								
NS-1 NO ACTION	0 (3)	0	0	0	0	0	0	0
NS-2 Rezoning of beach area	0	P	0	P	P	0	P	P
NS-3 Modification of building code	0	P	0	0	P	0	P	0
NS-4 Construction setback line	0	P	P	P	P	0	P	P
NS-5 Moratorium on construction	0	P	0	0	0	0	0	0
NS-6 Flood insurance	0	0	0	P	0	0	P	0
NS-7 Evacuation planning	0	0	0	0	P	0	P	0
NS-8 Establish a no-growth program	0	0	0	0	0	P	0	0
NS-9 Condemnation of land & structures	P	P	P	0	0	F	P	0
NS-10 Various combinations of above	-	-	-	-	-	-	-	-
<b>STRUCTURAL MEASURES (S)</b>								
S-1 Beach revetment	0	P	P	0	0	0	P	0
S-2 Beach fill w/periodic nourishment	P	P	P	P	P	P	P	P
S-3 Beach fill w/periodic nourishment stabilized by offshore breakwaters	P	P	P	P	P	P	P	P
S-4 Beach nourishment w/maintenance material from adjacent inlets	P	P	P	P	P	P	P	P
S-5 Beach fill w/periodic nourishment stabilized by groins	P	P	P	P	P	P	P	P
S-6 Seawalls	0	P	P	0	P	0	P	0
S-7 Beach fill w/periodic nourishment & hurricane surge protection - sand dune	P	P	F	P	P	P	P	P
S-8 Beach fill w/periodic nourishment & hurricane surge protection project stabilized by offshore breakwaters or submerged artificial reefs	P	P	F	P	P	P	P	P
S-9 Nearshore berms	P	P	F	P	P	P	P	P
S-10 Beachfill with nearshore berms	P	P	F	P	P	P	P	P
S-11 Stabilization of beaches & dunes by vegetation	0	P	P	P	0	P	P	P
S-12 Feeder beach	P	P	P	P	P	P	P	P
S-13 Relocation of structures	0	F	P	0	0	P	0	0
S-14 Flood proofing of structures	0	F	0	0	0	0	P	0
S-15 Abandon or modify navigation projects	0	0	P	0	0	P	0	0
S-16 Sand tightening of jetties	0	0	P	0	0	P	0	0
S-17 Upgrading on construction of sand transfer plants for renourishment	P	P	P	P	P	P	P	P
S-18 Various combinations of above	-	-	-	-	-	-	-	-

**NOTES:**

1 RB - Provisions of recreation beach  
 FP - Protection of flooding and wave damage  
 EC - Beach erosion control  
 TBE - Protection of tourist base economy

2 NED - National Economic Development  
 EQ - Environmental Quality

OSE - Other Social Effects  
 RED - Regional Economic Development

3 F - Fully meets objective  
 P - Partially meets objective  
 0 - Not meeting objective

a. Before WRDA 86, federal projects to protect against hurricanes and abnormal tide flooding were established on a case-by-case basis, based on specific Congressional authorizations. Hurricane protection projects were viewed as being more like flood control projects from an authorization perspective prior to 1986. With the passage of WRDA 86, there are now no federal distinctions between shore protection measures for hurricanes, storms or tidal induced flooding and beach erosion.

b. Shore erosion must be caused by wind and tidal generated waves; therefore, the shore protection program does not cover erosion at upstream locations caused by stream flows except for those actions defined as emergency measures to protect highways, public works, and non-profit public facilities.

135. Implementation costs of mitigation of the adverse effects of a Federal navigation project on adjacent shores will be shared in the same proportion as the implementation costs for the navigation project which caused the shore damage. Although Federal implementation of a federal navigation mitigation project may include costs for lands, easements, rights-of-way, relocations and disposal areas, the Federal Government will not incur costs for access rights over or on properties the mitigation proposal is designed to protect. The sponsor of a Federal navigation mitigation project must agree to operate and maintain the structural and non-structural measures of the mitigation project. Department of Army Engineering Regulation 1105-2-100 dated December 28, 1990 contains general program guidance for the Corps' Civil Works programs.

136. Current shore protection law provides for federal participation in shore protection, provided that the restored beaches are open and available for public use. Federal cost sharing is based on Federal law, policy, and conditions of shore ownership and use at the time of construction or subsequent periodic nourishment.

### **Screening of Initial Alternatives**

137. This section discusses the initial alternatives listed in Table 10 and selects those alternative retained for further evaluation.

a. NS-1 No action. The "no action" alternative allows the continuation of existing conditions and provides no solution to existing problems. However, it also avoids any undesirable effects that may be associated with structural or nonstructural plans of improvement. This option, although not favored by study sponsors in highly

developed areas of the study area, is considered a viable alternative in underdeveloped areas.

b. NS-2 Rezoning of beach area. Rezoning of the beach area and modification of building codes would result from the implementation of a construction setback line. This is a viable measure for reducing storm damages and is carried forward as part of the nonstructural combination plan of the intermediate alternatives.

c. NS-3 Modification of building codes. "Hurricane proofing," where sufficient time exists before hurricane landfall, can reduce wind and rain damage but has no effect on tidal-flood reduction. Revised zoning regulations, more realistic bulkhead lines and minimum fill elevations would also result in less tidal flooding. In areas where modified building codes could help prevent damages, it should be considered. Therefore, this alternative is carried forward as part of the nonstructural combination plan.

d. NS-4 Construction setback line. A construction setback line would not affect existing development and could only be effective in the unforeseeable future as buildings are razed and destroyed by storms and replaced, and as buildings are constructed on the remaining undeveloped land. The State of Florida has established construction control lines along the shores of coastal counties and through a construction permit program, based on this line, is controlling indiscriminate development along Florida's coastline. This alternative is included in the nonstructural combination plan, and plans are developed around it.

e. NS-5 Moratorium on construction. Moratorium on construction would be rejected by local interests since the desired growth of the area is oriented towards tourism and recreation, attracting retirees and promoting a stable construction industry. However, the State of Florida is currently addressing the problem of growth management both at the Governor's level and within the Florida Legislature. Although there is no Federal involvement in this effort authorized under this study, the impact of laws, policies and guidelines on growth management in the study area will be included in the evaluation of all alternatives considered.

f. NS-6 Flood insurance. Flood insurance, per se, does not prevent damage; it merely lessens the monetary loss of the individual property owner. This alternative is impacted by the limitations imposed on Federal expenditures under the "Coastal Barriers Resources Act" (COBRA) which could limit unwise development of the coastal area and is

carried forward as part of the non-structural combination plan.

g. NS-7 Evacuation planning. This is a nonstructural alternative which will be incorporated in the nonstructural combination plan.

h. NS-8 Establish a no-growth program. The establishment of a no-growth program is rejected by local interests but is one element of growth management plans being considered by the State Government. Growth in the area, particularly that in connection with beach activities, is needed to provide economic depth to the communities. This alternative is, therefore, included as part of the State's growth management efforts and will be considered in depth in the evaluation of all possible alternatives.

i. NS-9 Condemnation of land and structures. This alternative would allow the shoreline to erode in the area with a loss of land until shoreline equilibrium was established. This alternative does not provide any protection from erosion or wave damage but is implemented in some instances by the State in acquiring undeveloped shorefront properties. The alternative of buying undeveloped shorefront property to prevent future damages due to unwise development and to allow erosion to continue to nourish nearby beaches is an alternative that must be considered along with other non-structural alternatives.

j. NS-10 Various nonstructural combinations. It is recognized that various aspects of many of the preceding nonstructural solutions would be prudent to implement either collectively or in combination with structural alternatives. For the study shoreline, a single nonstructural plan is not applicable for the entire area.

k. S-1 Revetment. Revetments have been placed on beaches over the past to protect critically damaged or eroding areas. These measures have provided temporary relief, but have not reduced the erosion of the beaches. The hardening of the beach in one area can merely transfer the location of the problems further down the beach. However, to more fully determine the effects of hardfacing the shoreline, the revetment alternative will be carried at least through the intermediate alternative evaluation phase.

l. S-2 Beach fill with periodic nourishment. This alternative would provide a beach with project dimension size for recreational purposes as well as a buffer against wave attack. An offshore source of sand is considered as inland sources are unavailable due to environmental factors. Renourishment of the beach would be undertaken periodically

to maintain the recreational and erosion control features within design dimensions. Within the study area, about 55 miles of shoreline has been successfully renourished (29,103,000 cubic yards of sand have been placed on the coast of Florida during construction of authorized beach erosion control projects since 1970). This is therefore a viable alternative.

m. S-3 Beach fill with periodic nourishment stabilized by an offshore breakwater or submerged artificial reef. The construction of breakwaters or reefs offshore along the problem areas is considered as an alternative to reduce periodic nourishment quantities needed to maintain a protective and recreational beach fill. Such structures would reduce the amount of wave energy reaching the shoreline in their lee. The formation of a partial tombolo would occur if the breakwaters are of sufficient size, thus, decreasing the rate of annual erosion and thereby decreasing the annual nourishment requirements. This is currently under implementation in Region II of the study area and is being demonstrated as a viable alternative.

n. S-4 Beach nourishment with maintenance material from updrift inlet. This alternative is similar to the previous beach fill alternative, but takes advantage of the material which is obtained from the maintenance dredging from adjacent inlets. Maintenance operations or new work has not occurred on a regularly scheduled basis, also all of the dredged material from the inlet might not be suitable and, in most cases, have not been sufficient to satisfy the nourishment requirements; therefore, this alternative is considered as a supplement to offshore borrow areas and will be included in evaluation of alternatives.

This alternative also includes maintenance of beach fills adjacent to inlets by means of a sand transfer plant or other authorized methods of sand by-passing. Local interests (Palm Beach County and Boca Raton) maintain sand transfer plants at Palm Beach Harbor (Lake Worth Inlet), South Lake Worth Inlet, Boca Raton Inlet, and floating dredge for transfer at Hillsboro Inlet. The viability of sand transfer at inlets by dredge has been successfully demonstrated. However, the effectiveness of fixed sand transfer plants remains to be substantiated. The alternative of providing fixed sand transfer plants at inlets has been reasonably demonstrated as a viable erosion control measure. The economic feasibility of utilizing sand transfer plants will be evaluated as a feature of beach erosion control alternatives and will be included in the evaluation of detailed plans where appropriate.